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ABSTRACT

The five papers in this collection discuss various aspects of the Electronic Learning-Package Factory (ELF) project at the University of Bradford in England. In the first paper, "Adoption of CAL in Higher Education: A Cooperative Approach to Research, Development and Implementation," Philip Barker considers the opportunities for collaborative implementation of simple user-friendly software tools in computer assisted learning (CAL) in higher education. In the second paper, "The Computerisation of a UK University: The Bradford Experience," Tom Stonier, Stephen J. Fallows, and Andrew Radtke examine the background to the computerization project and the rationales behind providing networking facilities to the entire campus and encouraging ownership of microcomputers. In the third paper, "The Development of ELFsoft: A User-Friendly CAL Authoring System," T. R. King and S. J. Fallows examine a form-based design system called the ELF Starter Pack, which can be used by novice computer users to generate simple but sophisticated software. The features and technical requirements of the ELF Starter Pack are reviewed by T. R. King and S. J. Fallows in the fourth paper, "ELFSoft: A Simple But Effective CAL Authoring System." (In the fifth paper, "A Study of Attitudes towards Computerisation of the University of Bradford," A. L. Radtke and T. Stonier describe a survey of 190 students and 321 faculty designed to ascertain their opinions on computerization of the university, as well as to collect data on their current and projected usage of microcomputers. (DB)

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# PAPERS OF THE ELF PROJECT

by

Philip Barker
Tom Stonier
Stephen J. Fallows
Andrew Radtke
T.R. King

March 1990

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19 September 1990

**Electronic Learning-Package Factory (ELF)**

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B J Vaughn
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Dear Mr Vaughn

I am replying to your letter of 10 September to Professor Tom Stonier. Professor Stonier has now retired from this University and returned to his native USA.

However, to reply to your queries. Professor Stonier's paper "Computer-Based Education - A Global Overview" was only presented orally and unfortunately is not available in written form. You may though be interested in the enclosed copies of other materials presented by our group to the 7th International Conference on Technology and Education held earlier this year in Brussels, Belgium.

If you require any further information, do not hesitate to contact me.

Sincerely yours

Dr S J Fallows

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# ADOPTION OF CAL IN HIGHER EDUCATION: A COOPERATIVE APPROACH TO RESEARCH, DEVELOPMENT AND IMPLEMENTATION

**Philip Barker**


## ABSTRACT

The successful adoption of Computer Assisted Learning (CAL) in institutions of higher education requires a coordination of effort at a variety of levels. Within each institution coordination must be encouraged between primary academic departments and the CAL research, development and service units. The Electronic Learning-package Factory (ELF) project at the University of Bradford is such a CAL unit. Over and above local initiatives it would be most helpful if courseware and course modules could be shared between institutions and developed and tested in a collaborative way. A concerted effort involving departments across several institutions provides difficulties with respect to the provision of suitable tools for the production of courseware. However, the coordinated approach offers the opportunity to pool resources, and even more importantly, to evaluate software tools in a variety of disciplins and institutions. The University of Bradford has developed and established ELFsoft as a basic CAL authoring tool to be shared with other institutions. This paper considers the opportunities for collaborative implementation of simple user-friendly software tools in CAL for higher education. This is discussed in the context of other British and European initiatives in higher education.


## INTRODUCTION

If computers are to be widely used as an educational resource in higher education it is essential that three basic requirements are fulfilled. First, appropriate hardware resources must be provided. Second, a suitable infra-structure must be created in order to allow electronic learning to take place. Third, a wide range of quality courseware must be created.

Ideally, any campus automation project will make available a wide variety of hardware resources. For example, students will have low-cost (but powerful) portable computers which can be used both at 'home' and on the campus. Electronic classrooms will be provided as will a range of different types of Open Learning Centre. Of course, the campus must be 'wired' so that all study locations, offices and departments can communicate with each other by electronic means. Individual campuses should also be able to communicate with each other in this fashion - both nationally and inter-nationally, thereby facilitating the global exchange of courseware resources.

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The infra-structure that is created to allow electronic learning to take place must facilitate the co-existence of conventional methods of instruction (where these are appropriate) alongside the new methods that are based upon information processing technologies. Systems of examination and assessment will also need to accommodate the use of new technologies. Of course, staff roles and attitudes will also need to change; instead of being instructors and 'knowledge disseminators' staff will become facilitators, advisors and directors of study. In some cases they will also take on the role of courseware authors.

Of course, it is the responsibility of courseware authors to provide the wide range of instructional software that is needed to support campus automation projects. This courseware must be robust and stimulating. It must challenge the learners to learn. It must also allow its users to employ many different styles and strategies of learning. Naturally, courseware that meets these requirements is often difficult to design, time consuming to produce, and expensive to deliver. It is therefore important that: (a) highly automated methods are used; and (b) collaborative development strategies are employed wherever this is possible. The remainder of this paper discusses these issues.

## COURSEWARE ENGINEERING

The disciplin of courseware engineering is concerned with the development of methods and tools for producing instructional software. Many different types of tool are currently employed for the creation of courseware [1, 2]. They differ quite considerably with respect to: (a) their user-friendliness; (b) the facilities they offer; and (c) the extent to which they automate the development process [3].

Wherever their use is appropriate we advocate that authoring systems should be employed for the production of professional courseware - mainly due to the fact that they can lead to a substantial reduction in the amount of effort needed to develop high quality resources. Because of its easy to use, graphical interface we have used the PROPI system in much of our work [4]. PROPI generates PC/PILOT code that can be 'hand edited' or run directly on any suitable PC compatible.

Although PROPI and PC/PILOT are powerful and useful CAL development resources, situations often arise in which there is a demand for either a simpler or a more sophisticated tool. Indeed, the type of tool that is needed often depends upon a particular courseware author's prior experience in this area. In order to fulfil the requirements of both novice users and more experienced CAL developers we have found the KnowledgePro authoring shell to be particularly useful [5, 6]. Two of its most attractive features are: (1) the ease with which existing CAL resources can be embedded within it; and (2) the facilities it offers for generating other authoring tools. This late aspect is discussed in more detail in the following section.

## ELECTRONIC LEARNING-PACKAGE FACTORIES

The concept of an Electronic Learning-package Factory is an important one since it projects the idea of courseware developers working collaboratively to produce educational products for use in CAL environments. Of course, there are two important considerations that need to be taken into account: (a) the availability of suitable automation tools to facilitate courseware generation; and (b) the global portability of the resources that are produced. The ELF project at the University of Bradford is currently studying each of these problems. We are investigating how would-be developers may employ easy-to-use tools (such as ELFsoft [7]) in order to become proficient in CAL lesson development. We are also investigating how sharing of courseware can be achieved using both computer networks and digital optical storage facilities.

## CONCLUSION

The sharing of courseware on a national basis is a difficult problem. Because of cultural and language barriers such sharing on a world-wide or even a European basis is much more difficult to achieve. However, if the cost of producing quality courseware is to be reduced substantially it must be undertaken on a European or world-wide basis. Therefore, cultural and linguistic barriers must be overcome if this is to be successfully achieved. Furthermore, it is imperative that a world-wide network of electronic learning-package factories be set up so that valuable and scarce expertise and resources for developing quality educational products can be shared.

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# THE COMPUTERISATION OF A UK UNIVERSITY
# THE BRADFORD EXPERIENCE

Tom Stonier, Stephen J Fallows and Andrew Radtke*

ABSTRACT

The University of Bradford is undertaking a programme of total computerisation. In addition to providing networking facilities to the entire campus ( including teaching and research facilities, administrative centres, the library, the computer centre, and all student study/bedrooms), the University is encouraging all students and academic staff to purchase their own personal microcomputers.

This paper examines the background to the computerisation project and presents the view that any education establishment which does not adjust to the opportunities offered by information technology in research and teaching is depriving its students of valuable experience.

## INTRODUCTION

The present exponential growth in information technology (IT) is markedly altering both our professional and personal lives. Any education establishment which fails to adjust to these changes will be left behind. Furthermore, any education establishment not fully utilising the potential offered by IT in its teaching and research is depriving its students of valuable experience. Similarly, IT provides an excellent tool for staff to increase the quality and productivity of teaching, research and administration, as well as enhancing the community life of the university. It was in recognition of these factors that the University of Bradford, a technological university in the North of England, has introduced a programme designed to provide for total computerisation of university facilities. This paper examines the justifications for the computerisation of Bradford University (CBU) and briefly introduces the implementation of the programme. The practical details of computerisation are discussed further in Ref 1.

## THE COMPUTERISATION CONCEPT

The computerisation programme seeks to establish a system in which all University facilities (offices, teaching areas, laboratories, administration, student study/bedrooms) are linked by a computer network both to each other and to central facilities such as computer centre and library. In addition, this network permits access to the wider academic community through the Joint Academic Network (JANET) both within the UK and internationally. The programme calls for a cooperation

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between the University and its staff and student members, since the University is encouraging the personal ownership of the microcomputer workstations.

## JUSTIFICATION FOR PERSONAL OWNERSHIP

The University of Bradford is opting for personal ownership of the microcomputers (rather than merely providing such from University resources) and therefore is unique amongst UK universities, although this approach has been adopted elsewhere in the world, most particularly in the USA. Personal ownership is vital to the successful computerisation of universities for the following reasons:

A. In the Information Age people will become used to owning a computer of their own. There is a vast difference in attitude towards the equipment and its use if it is owned rather than merely provided. It can be used at weekends and holidays. The care taken is far superior to that afforded to university property. Furthermore, because personal investment has been involved, usage levels are maximised. There is a self-interest in learning how to use the computer and hence training becomes much more acceptable.

B. The present rate of technological development is such that a new generation of computers appears about twice in every decade. If a university provides computers, it becomes frozen into a system which will need repeated updating every five years. This capital replacement is clearly very expensive. Personal ownership serves to perpetually update the system as new students (and staff) purchase the newly available models.

In order to encourage purchase, the University has offered a modest subsidy to permanent members of the academic staff. In addition, preferential discount prices have been negotiated with a supplier of a range of IBM compatible PCs and a wide variety of software is available either "bundled" with purchased computers or on University site licence.

Support for CBU has been provided by the Universities Grants Committee (for networking, central facilities, staff subsidy), the Computer Board (for additional networking facilities) the Enterprise in Higher Education scheme (for training) and the Training Agency (for research and development to support the adoption of computer-based learning (CAL) methods).

## RATIONALE FOR EXTENSION TO OTHER UK UNIVERSITIES

The Bradford experience is also applicable to other UK universities. Most universities have undertaken some degree of computerisation and with proper planning and support most universities could achieve a state of total computerisation within a period of around three years.

The total computerisation of the UK university sector would have major educational benefits but would also bring economic benefits. The expenditure involved would stimulate local industry to provide systems and support. More importantly, the university system would itself be significantly up-graded. The national resource of human capital would be enhanced through the value - added by education. The computerisation of higher education would serve as a major stimulus to this process. An average additional investment of around L1 million per university would provide the stimulus required and would yield the most advanced university system in the world. The additional investment would be repaid many times over by the improved quality of graduates and the potential to attract additional students from all over the world.

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# THE DEVELOPMENT OF ELFSOFT: A USER-FRIENDLY CAL AUTHORING SYSTEM

T R King and S J Fallows*

## ABSTRACT

The Electronic Learning-package Factory (ELF) at Bradford University is researching ways of introducing CAL into higher education. ELF identified major problem areas with currently available authoring software which precluded its immediate use. This lead to the ELF Starter Pack; essentially a form-based design system which can be used by novice computer users with a word processor and the ELFsoft authoring package to generate simple but sophisticated courseware.

## BACKGROUND

As part of the computerisation of Bradford University (CBU), ELF is funded by the Training Agency to develop a computer-assisted learning (CAL) authoring workstation. The ultimate aim of the project was to facilitate the widespread use of computer courseware at University level. After a decision by the CBU team to promote IBM PC compatible equipment, ELF investigated several of the leading CAL authoring systems for PC's (eg. Topclass, PROPI and Mentor) assuming that one of these, combined with suitable multi-media equipment, would form a ready basis for the workstation.

## RESULTS OF THE INITIAL INVESTIGATIONS

The initial investigations revealed four major problem areas:

a) Software complexity. Although offering many features for the production of CAL, the authoring packages investigated were complex; too complex, we believed, for novice computer users, like University academics, who did not possess programming skills or the resources or immediate interest to acquire those skills.

b) Design Complexity. In addition to the software itself, the production of a piece of CAL courseware demanded particular educational and design skills at a professional level. For example, establishing the aims and objectives of a course, designing the course to include the features of presentation, assessment and prompt response (ref 1) and evaluation.

c) Hardware Complexity. One important feature of CBU was that staff and students would be encouraged to buy their own computers. A package of cheap finance for bargain PC clones was introduced. Authoring software would have to work on a wide range of PC's, all with hard discs, but with either mono-

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Hercules of colour VGA monitors. We believed that the students would be attracted to the cheapest computers with Hercules monitors. We found that our commercial software was overwhelmingly aimed at PC's with colour EGA/VGA monitors. We were faced with the problem that authored software might not be deliverable to students on their own machines.

d) Licensing and Publishing Complexities. The commercial software we investigated was generally sold with an expensive site license (which may have been limited to development work on the University campus alone) and often there were expensive publishing licenses for the right to sell or distribute courseware. We felt that it was important that as universities in Europe moved closer together (even towards the development of an 'Electronic University' (ref 2), no staff member should feel restricted in sharing or distributing CAL course material.

## STRATEGY FOR FUTURE DEVELOPMENT

In an attempt to overcome the above problems, we devised the concept of the ELF Starter Pack (ESP) with the following features:

a) Easy to use authoring software, ELFsoft, designed to allow a novice computer user to create a simple but effective piece of courseware. The resulting courseware would be structurally simple but include sophisticated features (like hypertext) which would make it educationally acceptable at University level.

b) An integral form-based design system so that users new to CAL would be able to learn the rudiments of CAL design from the simplest level. It was important that the author, possibly working from a sketchy design, to conceive simple courseware and convert it into a design for CAL in a fairly straightforward manner.

c) A facility by which existing wordprocessed text (eg lecture notes) could be incorporated into CAL. This would save time and capitalise on the current experience of many academics with wordprocessing. Introducing them to CAL by a process with which they were already familiar.

d) Allow delivery of CAL on a wide range of PC's including the most basic student machines viz. a PC-XT with hercules monitor, a single 720K 3.5" floppy disc drive, and a 20MB hard disc drive (although this would not be essential).

e) ELFsoft would be free of all licensing and publishing charges or restrictions. Academics could then distribute their material widely, share courseware, or start to build up courses jointly between institutions.

f) ELFsoft would be devised so that it could act as an interface to user written programs for simulations, modelling etc. as well as some generic software.

g) Although the original ESP would be text-based, it would be designed to allow for an upgrade path in the same style to incorporate graphical screens, CD-ROM, video-disc etc. as this technology became more widespread.

## OTHER AIMS FOR ESP

The aim of ELFsoft is to develop short pieces of courseware with a very specific aim and essentially to provide the author with a very simple structure in which to develop their own complex ideas. Documentation provided for ESP would contain suggestions about how a piece of CAL courseware could fit into a total course comprising printed material, other software (like simulations), tutorials and lectures (ref 3). The entire approach would encourage lecturers to organise their material logically and in small self-contained units. This would fit entirely with moves towards modularisation and credit based couses in higher education. Finally it was hoped that experimentation with ESP would stimulate wider interest in CAL and good CAL design and promote progression to more advanced authoring software.

## CONCLUSIONS

As a result of this strategy a prototype and first version of ESP has been developed. It comprises 12 design forms which can be mixed and matched in any sequence, keyed into a wordprocessor to produce a text file which is then interpreted by ELFsoft TEACH to deliver a course. For ease of development an interactive facility WRITE is included to create the course file directly (ref 4).

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# ELFSOFT: A SIMPLE BUT EFFECTIVE CAL AUTHORING SYSTEM

T.R.King and S.J.Fallows*

## ABSTRACT

ELFsoft is easy to use authoring software developed by the Electronic Learning-package Factory (ELF) at Bradford University as part of their ELF Starter Pack (ESP) for novice computer users. Developed to encourage staff in Higher Education to experiment with CAL, it has many features (including hypertext) and all courseware can be generated from a form based design system using a word processor. It is distributed as shareware to run on basic IBM PC compatibles.

## BACKGROUND

The ELF project at Bradford University was funded by the Training Agency to research ways of facilitating the adoption of computer assisted learning (CAL) methods within both the University and at other institutions of higher and secondary education. One result is the development of ESP including the ELFsoft CAL simple authoring package (ref1).

## ELF STARTER PACK

ESP has been developed for the non-computerate user. It comprises:

a) A set of design forms. One for each CAL component made available by the ELfsoft tutorial software (TEACH). The forms are completed by the user and assembled, in any order, to make up the content of a short piece of CAL courseware. (See Fig.1 for an example form). The forms can be typed using a wordprocessor to generate a simple text file.

b) The ELFsoft starter authoring software. This has several features but the tutorial software, TEACH, will interpret the text file created using the forms and deliver CAL courseware.

## FEATURES OF ELFSOFT

The text version of the TEACH ELFsoft Tutorial Software has several features:

- Text screen displays with page forward and back facility.
- A choice of question components which each ask a question, allow answer input or selection (with multiple tries), display the answer input and then make a response based on the answer. Question types are:
    * Yes/No and True/False
    * Multiple Choice from 2-6 entries

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    * Entry of word/number response from keyboard
    * Multiple selection from 2-6 entries.
- Hypertext on marked words/phrases in the text with the facility to nest hypertext references.
- A facility to create sections which allow division of the tutorial into logical, headed sections, provide a bookmark facility, reports on progress and optional section repeat.
- Exit from the tutorial to a piece of user-written software (or to MS-DOS) with automatic return to the tutorial.
- The creation of a management file which records basic data about the students performance from which statistics can be generated using the STATS software. This file (like the hypertext references) need not be on the student machine but accessed via the network.

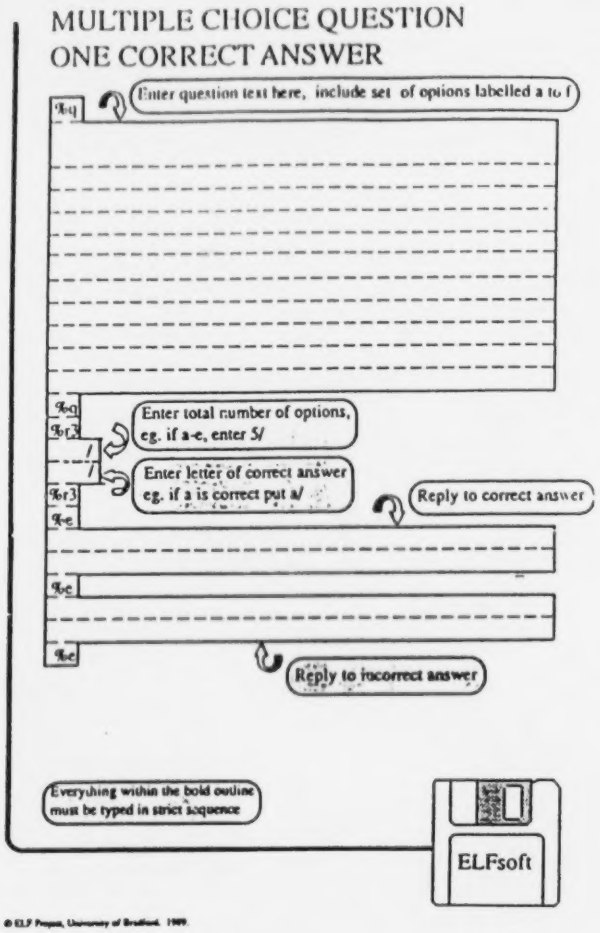
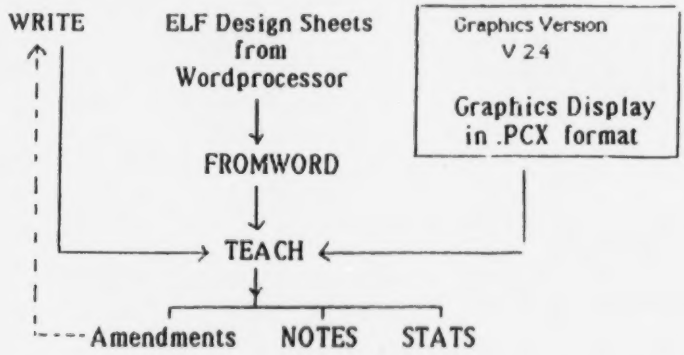

MULTIPLE CHOICE QUESTION
ONE CORRECT ANSWER
Enter question text here, include set of options labelled a to f
Enter total number of options, eg. if a-e, enter 5/
Enter letter of correct answer eg. if a is correct put a/
Reply to correct answer
Reply to incorrect answer
Everything within the bold outline must be typed in strict sequence
ELFsoft

Fig.1 Specimen Multiple Choice Design Form

STRUCTURE OF ELFSOFT

The ELFsoft Package has the following structure:




Wordprocessed text sheets are saved in ASCII and converted by the FROMWORD software into a form accessible to TEACH. As a direct, alternative route using the WRITE software, a tutorial may be built up interactively. Also, amendments to any tutorial script may be made using WRITE. The NOTES software will take the textual content of a tutorial and hypertext references and print paged lecture notes.

TECHNICAL REQUIREMENTS

After some consideration of high level languages, ELFsoft was written in KnowledgePro (ref 2); an artificial intelligence interface which offers a WIMPS environment with features like hypertext. ELFsoft is capable of delivering courseware on a full range of IBM compatible PC's including a PC XT with a single 3.5", 720K floppy disc drive and monochrome monitor. For the authoring process itself a hard disc drive is required and, although optional, a mouse is recommended. The Graphics Version of TEACH will display colour graphics screens and graphical hypertext with hypertext 'buttons' but an EGA/VGA colour monitor is needed. The manual offers full instructions for installation and running of the software. It also deals with other topics like rudiments of good CAL design and construction of courses using CAL as one component. A number of example tutorials are also included. ELFsoft is intended to be distributed as shareware to educational institutions with the required hardware.

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# A STUDY OF ATTITUDES TOWARDS COMPUTERISATION OF THE UNIVERSITY OF BRADFORD.

A.L. Radtke, T. Stonier° .

## ABSTRACT

A study is being made of attitudes of staff and students to the University of Bradford's computerisation project (ref 1).
Surveys were carried out in April 1989 of students, and May 1989 of staff. They showed that just under three quarters of the student respondents knew the university was going to computerise and over a third said they would buy a computer to use as part of the project. 58% of student respondents surveyed said they used a computer at least once a week. 59.5% of staff respondents said they would buy a computer to use as part of the computerisation project, and 80% of staff who replied said they used a computer at least once a week. Overall, the most popular use for computers at the university as indicated by both staff and students is word processing.
Some work is also being carried out to study the attitudes of staff displayed in interviews on the subject of computerisation. The study of these interviews has commenced with an analysis of nine members of the university's higher administration. It was found most were in favour of the project, some more cautious than others.

## INTRODUCTION

The University of Bradford is presently undergoing a process of computerisation. The university's programme for the early 1990s aims for each member of the academic staff and each student to own a personal computer. The computerisation programme, which has been supported by the University Grants Committee, seeks to transform the university into an electronic campus. Each personal computer may be used as a stand-alone machine or may be linked into central university facilities such as library or mainframe computer or may be used in communications with machines owned by other members of the university.
This paper describes a programme of work designed to observe the attitudinal changes amongst university staff and students prior to and during the initial implementation stages of the computerisation programme.
The research methods used fall into two areas. Firstly analysis of taped interviews on the subject of computerisation with many members of the university's staff. These interviews have been carried out since 1987. Secondly, surveys of students and staff at the university. It is intended to repeat the survey work at yearly intervals.

## SURVEY WORK CARRIED OUT

One hundred and ninety students, 77 (40.5%) female and 113 (59.5%) male, were surveyed, by using face to face interviews with students in halls of residences and in the main Richmond Building of the university. All the survey work was done during the last week of the Spring term in the academic year 1988-1989, that is, between 10th March 1989, and the 17th March 1989. It was left to chance what the distribution of courses, years, and gender would be.
The staff questionnaire was sent out to all academic and academic related staff at the university on the 15th of May 1989. This was prior to the university making any announcement of the prices of computers purchased under the computerisation scheme and before sales began. Out of these 684 people, 321 replied, a response rate of 46.9%. Comparison with actual distribution of university staff showed that the respondents represent a fair sample of the university's academic staff and is representative of departments. 79.1% of respondents were male, 20.9% being female.

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Members of staff at the university have been interviewed about this project. Most of these interviews have been recorded on cassette tape. Work in this area is ongoing, but an internal report on the attitudes of the university's higher administration has been completed. A system has been developed to rank attitude of staff numerically.

## RESULTS

It was found that 88.5% of of staff used computers regularly, as did 78.9% of students.
Staff and students that said they used computers were asked how often they used computers, which sort of computers they use, and what they used them for. Results from these questions can be seen in Figures 1, 2 and 3 respectively.
Other data also shows students are more likely to use computers if they are male. This is reflected throughout the student work, in which male students appear to be significantly more aware of computers than females.
The samples were asked if they would buy computers under the computerisation scheme. 59.5% of the staff said they would buy a computer under the scheme, with 19.6% saying No, and 20.9% Don't Knows. Most of the staff who said they were going to buy a computer said that they would be using it at home. 35.8% of students said they would buy the computers, with 43.2% saying they would not and 21.1% saying they didn't know. The students were also asked if they would buy a computer using a cheap bank loan. This increased the number of people who said Yes to a purchase to 38.9%. The number of Nos reduced to 34.7% and the Don't Knows dropped to 26.3%.
The data culled from study of the tapes of members of staff indicates that the majority of staff are generally in favour of the project. Some indicated caution on the subject; but all generally thought that the project was worthwhile.

## CONCLUSIONS

Even taking into account possible inaccuracies made in gathering and interpreting data, the conclusion appears inescapable: Computers are already widely used by the staff throughout the University. That means that even if, taking an extreme example, all the members of staff who did not reply to the survey do not use computers in any way, then still 41.5% of staff at the University are using computers in some way. This is clearly an absolute minimum, and the real figure must be much closer to the 88.5% that results from the survey suggest.
Throughout the student survey there were significant differences between the responses of males and females, and computer users and non-computer users. Females, and people who don't use computers, are less likely to know about the computerisation project, and are less likely to buy a computer. There is however a large proportion of students who are willing to become part of the project by buying computers.
It is indicated by the respondents that staff tend to use computers more frequently than students (Figure 1). The computers in most use by the the students are the University's mainframes, whereas the staff are more likely to use PCs and clones (Figure 2). Word Processing is the most common use for computers with both the staff and students (Figure 3).

## REFERENCES

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## ACKNOWLEDGEMENTS

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**Figure 1: Frequency of Computer Use**

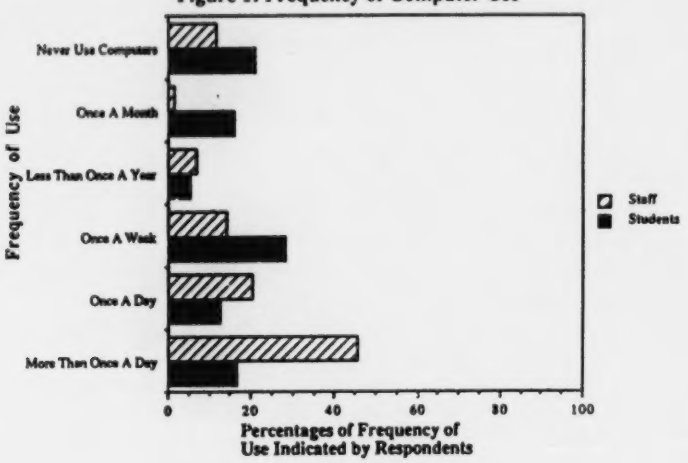


**Figure 2: Computers Used**

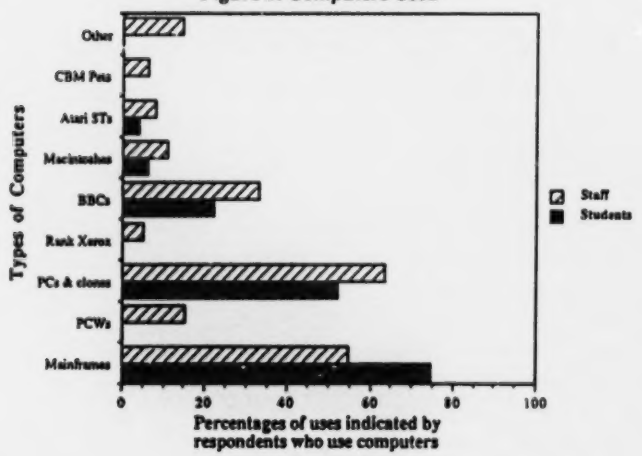


**Figure 3: Use of Computers**